IEEE P1157 Medical Data Interchange (MEDIX) Committee Overview and Status Report

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Abstract

Working under the auspices of the Institute of Electrical and Electronic Engineers Engineering in Medicine and Biology Society (IEEE EMBS), the IEEE P1157 Medical Data Interchange (MEDIX) Committee has been chartered with developing international standards for communication of medical information between heterogeneous healthcare information systems. The IEEE P1157 Standards are based upon, and will conform to, the International Standards Organization (ISO) Reference Model for Open Systems Interconnection (OSI)[1].

The IEEE P1157 Committee has adopted a phased approach and is working towards balloting the initial standards, which apply to communications between a patient care system (PCS) and selected ancillaries in the medical center setting.

A parallel, longer range effort, focused on developing a reference model for electronic exchange of the medical record structure, content, and related medical knowledge, is in progress.

IEEE P1157 Committee Background, Objectives and Organization

Background

During the 1986 MEDINFO Conference, an international group, representing both end users and systems vendors, determined that the development of standards for communication of medical data between heterogeneous healthcare information systems is a necessary condition for accelerating the diffusion of automated information systems technology in healthcare. The organizers of what was to become the IEEE P1157 Committee also realized that, to provide maximum value, the development of communications standards for healthcare should have both an international scope and a policy of open participation. Based upon these objectives a proposal was submitted to the IEEE to sponsor the development of the required standard.

In 1987 the IEEE Standards Board approved the formation of the IEEE P1157 Medical Data Interchange (MEDIX) Committee under the auspices of the IEEE EMBS . In an organizational meeting held in conjunction with SCAMC in Nov 1987 the IEEE P1157 Committee defined its charter to "Specify and establish a robust and flexible communications standard for the exchange of data between heterogeneous healthcare information systems" [2].

Objectives

During the Nov. 1987 meeting the IEEE P1157 Committee defined the following objectives :

1) Support both inter and intra medical center communications, among patient care settings and ancillary services

The eventual scope of IEEE P1157 is all of healthcare communications, both in the medical center, between medical centers, and between individual providers and medical centers.

2) Do not assume a particular decomposition of the healthcare system into subsystems

3) Structure the standard in a flexible manner, so that multiple subsets of features are allowed

Taken together objectives 2 and 3 reflect the goal of the IEEE P1157 Committee to minimize the constraints upon systems implementations which conform to the IEEE P1157 Standard. Technical approaches to meeting these objectives include the specification of functional profiles to support various levels of capability, allowing user defined abstract syntaxes as extensions to the standard abstract syntax, the use of object oriented abstractions as the basic architectural building blocks, and other related techniques.

4) Provide a framework allowing the migration of applicable healthcare standards into a common reference model

The IEEE P1157 Standard is not the only healthcare communications standard. The unique features of IEEE P1157 are its broad scope, its international and open development process under the auspices of an international standards setting body, and its focus on conformance to the ISO/OSI reference model and associated standards. The IEEE P1157 committee has set goals of utilizing existing standards wherever possible and of providing a common reference model for convergence of existing standards to the OSI environment.

5) Define a standard set of interface transactions which allow healthcare information systems to exchange data.

6) Specify standard representations of transaction data items, while allowing for domain specific variations.

The reference model for IEEE P1157 consists of a set of standardized objects which interact through transactions.

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Objectives 5 and 6 restate the overall goal of minimizing the constraints placed upon the implementations of healthcare systems based upon IEEE P1157.

7) Insure data integrity, consistency, security, reliability and ownership.

These are necessary conditions for a communications standard for use in healthcare. The unique constraints on cost/performance and the need for healthcare delivery to continue in the face of failures of part or all of the automated information system impose significant constraints on recovery mechanisms for IEEE P1157 Standards.

8) Insure compatibility of multiple vendor systems at the applications interface level through the use of ISO/OSI Application Service Element standard protocols.

The IEEE P1157 Committee believes that by basing IEEE P1157 on the ISO/OSI standards the healthcare community will be able to leverage the enormous investment in time and resources which the communications and data processing industries have made in developing these standards. The use of the OSI elements allows the IEEE P1157 Standard to focus on only those areas which are unique to healthcare, while capitalizing on what will soon be a widely available infrastructure which is being developed for the information technology community as a whole.

9) Insure that successive protocol versions are compatible.

The needs of healthcare in the area of automated information technology are expanding rapidly. Any standard developed today must provide for evolution over its useful life, which is measured in decades. In order to protect the investment of scarce healthcare resources it is essential the healthcare communication standards provide mechanisms for evolution and allow for backwards compatible operation.

Organization

In terms of demographics, slightly more than half of the membership consists of healthcare professionals as compared to healthcare information systems vendors. This is consistent with the IEEE P1157 Committee's goal of establishing balance between end users and developers.

From the standpoint of international participation, approximately 75% of the IEEE P1157 Committee resides in North America while 25% resides in the rest of the world, primarily in Europe.

Recognizing the increasing international participation in MEDIX, the IEEE P1157 Committee voted in May of this year to create regional MEDIX groups consisting of a Vice Chair representing each region and parallel subcommittee and working group structures in each region. The North American and European MEDIX organizations have been defined, and work is in progress to establish the appropriate groups for the Pacific Rim.

The regional MEDIX groups were created to facilitate wide participation by the international community, while minimizing the need for travel for individual members. To coordinate the activities of the regional MEDIX groups each document will be developed as a single document with co-editors from the various regions.

Regional groups are free to meet as often as necessary, however only those ballots which are taken in the General Committee meetings, which are currently held on a quarterly basis, are binding on the MEDIX Committee.

The Framework Model and development process which have been selected by the IEEE P1157 Committee are discussed in the following sections.

Initial Focus and Development Process

In defining the overall scope of IEEE P1157 the committee recognized that there is a "window of opportunity". Individual vendors and end users need standards now. In addition, products implementing the OSI protocols, and which IEEE P1157 will use as a platform, will begin to be widely available from data communication system vendors in 1990.

The combination of the need of the healthcare community for standards in specific areas as soon as possible, and the desire to avoid a proliferation of incompatible healthcare communication standards based upon OSI, led the committee to establish an initial focus on patient care systems and their interfaces with the following healthcare information systems

* Registration/ADT
* Pharmacy
* Laboratory
* Respiratory
* Finance/Statistics

Each of the IEEE P1157 documents has an editor assigned from each region. The co-editors are responsible for the progression of the document and for harmonization of the document contents between the regions. To facilitate the communications involved in coordinating international workgroups, the IEEE P1157 Committee is moving towards the use of electronic communications for document development, distribution of MEDIX literature such as minutes of meetings, and for prototyping. Network servers have been established in the US and Europe, and an active effort to move all of the participants to electronic communication is underway.

As the draft documents are stabilized, the editors coordinate with the prototyping subcommittee which is responsible for validating the proposed standards through independent development of interworking prototypes based upon the standards.

The specific initial focus which the majority of the committee is working on is complemented by a longer term, parallel effort concerned with investigating the definition of a reference model and appropriate communication protocols for the electronic exchange of the medical record structure, content, and related medical knowledge. This longer term effort is looking at both intra and inter medical center communications as well as communications between individual providers and medical centers.

As interest in MEDIX grows, there is an increasing need to provide education regarding the activities of the IEEE P1157 Committee and the standards resulting from this effort. The Education and Publicity Committee has the responsibility of defining the combination of papers, presentations, and other communications required to inform the healthcare community about MEDIX.

Framework Model

IEEE standards are developed by individuals who volunteer their time, and are adopted based upon the principle of consensus. Coordinating the efforts of a large, international, volunteer, group to achieve consensus while efficiently accomplishing an overall task of the scope of MEDIX, requires definition of a framework which allows decomposition of the effort into a set of relatively independent tasks. The subtasks must be of sufficiently limited scope to facilitate efficient work by groups that are small enough to promote efficient communication.

To establish a common conceptual model, both for purposes of partitioning the MEDIX effort, and for interaction with other standards groups, the MEDIX Committee developed the Framework Model shown in Figure 1.

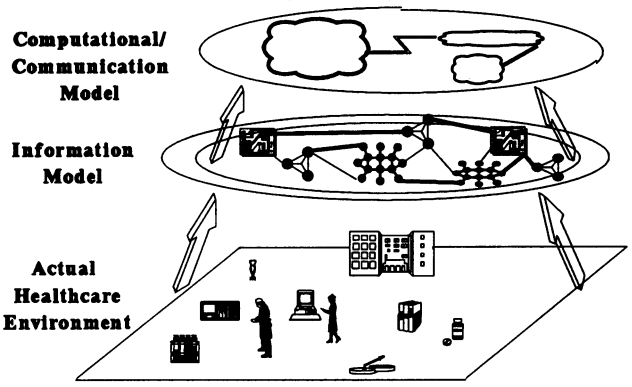

Figure 1 Framework Model for Healthcare IT

The Framework Model [3,4] views an automated healthcare IT system as a computer based model of an abstraction of the underlying real healthcare environment.

In the general case, the system is based upon an integrated set of heterogeneous applications and computational platforms, although the MEDIX Standards are applicable in other environments as well.

For the purposes of this survey it is sufficient to note that the Framework Model can be used to partition the overall standard into three distinct, but related, areas. These are :

1) The **information model** [5,6]

2) An application level **interchange format** for message exchange [7]

3) A **communications profile** defining the generic communications "stack" for particular application domain. In each of these areas the choices made serve to distinguish the applicability of a particular standard for a given application environment.

Information Model

In order for meaningful information exchange to occur in any environment it is necessary for the respective participants to establish a shared information model of the domain of discourse.

Based upon the objectives stated earlier, the IEEE P1157 Committee is developing an object oriented information model for MEDIX [4,6]. In particular, the use of the object oriented information model, provides for separation of specification from implementation through the abstraction of encapsulation, and provides a means for evolution with backwards compatibility through the abstractions of inheritance and polymorphism. The MEDIX Information Model will allow for representation of all types of medical data including text, images, graphics, waveforms, and voice.

It is important to note that the information model has utility independent of any automated system, in that it has the potential to reduce ambiguity in healthcare communication outside of any automated system.

Interchange Formats

It is the intention of the IEEE P1157 Committee to leverage existing standards wherever possible, and in particular, to build upon base standards approved by the International Organization for Standardization (ISO). The ISO Open Systems Interconnection (OSI) - Basic Reference Model [1] defines a seven layer model which provides a framework for specification of services and protocols for communication in an open systems environment.

Referring to the Framework Model shown in Figure 1, in keeping with the objective of not assuming a particular decomposition of the healthcare system into subsystems, MEDIX assumes that both the applications which make up the system and the computational platforms can, and will be heterogeneous. Also the MEDIX standards do not impose any constraints on either the distribution or "ownership" of data. In particular MEDIX supports both centralized and distributed policies for both location and ownership of information.

An instance of communication occurs whenever information must be exchanged between two or more applications. In general this occurs when, as a result of changes in the real healthcare environment, there is a need to communicate information to all applications affected by that change. For example, admission of a patient may result in information transfer from an Admission / Discharge / Transfer application to a number of other applications.

MEDIX takes the view that the messages that are exchanged in a particular instance of communication are the result of a mapping of the relevant portions of the common information model onto a particular interchange format.

Although there is a desire to minimize the number of interchange formats that must be supported in the healthcare sector, no one format has been identified which meets the user needs in terms of simplicity and expressiveness. Currently the IEEE P1157 Committee has identified three application level interchange formats that, in combination, meet the needs of the healthcare community, as they are currently understood, these are :

1) EDI (Electronic Data Interchange) [8] : for the exchange of text based messages, such as orders and results, which can be modeled as "electronic forms", and are primarily intended for machine processing.

2) ODA/ODIF (Office Document Architecture/ Office Document Interchange Format) [9,10] and

SGML/SDIF (Standard Generalized Markup Language/ SGML Document Interchange Format) [11] : for complex multimedia "documents" combining text, images, voice, and other complex data types which are intended either for machine processing or for presentation to a person.

3) CMIS (Common Management Information Services) [12] : for interactive exchange of complex data types intended for machine processing such as medical device communications.

Communication Profiles

The OSI services and protocols have been developed with the goal of meeting the needs of broad classes of users. As a result of the differing needs of various application classes the base standards contain a variety of options. In order to insure interoperability for a particular function it is necessary for all of the participants to select the same set of options.

A profile is defined as "a set of one or more base standards, and, where applicable, the identification of chosen, classes, subsets, options, and parameters of those base standards necessary for accomplishing a particular function" [13]. An International Standardized Profile (ISP) is "An internationally agreed to, harmonized document which identifies a standard or set of standards, together with options and parameters, necessary to accomplish a function or set of functions"

To the extent possible, MEDIX will be based upon ISPs. At the present time the candidate MEDIX profile is based upon the Government OSI Profile (GOSIP), as shown in Figure 2.

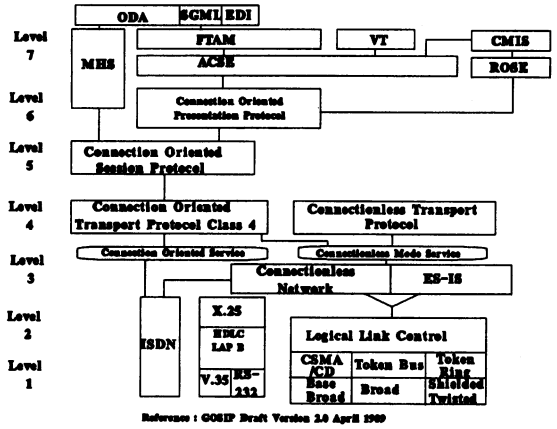

Figure 2 GOSIP Profile as a Basis for MEDIX

Document Structure

Based upon the Framework Model the IEEE P1157 Committee has defined the document tree shown in Figure 3. The document tree consists of a root Overview document which describes the MEDIX Architectural Reference Model and the Framework Model for the MEDIX standards, an Information Model standards branch, and a Communications standards branch. In both the Information and Communication models branches there is a methods document describing the outline and required contents for other documents in that branch. The information model documents have been divided into Common Medical Objects, which have a broad range of application, such as person, and Specific Medical Objects which apply to a particular medical domain such as Clinical Laboratory.

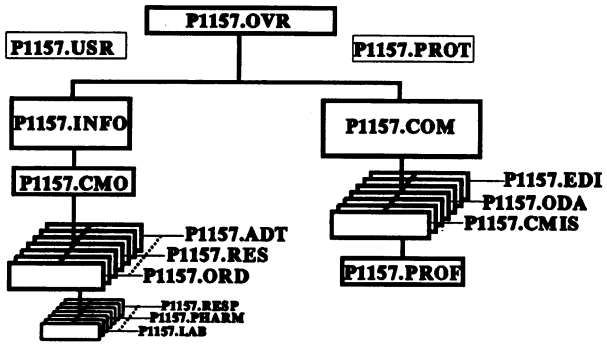

Figure 3 IEEE P1157 Document Tree

Relationship to Other Standards

The IEEE P1157 Committee recognizes that other groups are actively involved in developing communications standards for healthcare. Given that each of these groups has its own objectives the possibility for overlapping and conflicting standards exists. To prevent such a situation from occurring, representatives of groups involved in the development of healthcare communications met with representatives of communities of end users of these standards in Washington DC in January of 1988. The meeting focused on defining methods for allowing independent development of standards while minimizing the potential for incompatibility between the different standards. The result of that meeting was the formation of the Healthcare Information Standards Coordinating Committee (HISCC).

The stated purpose of the HISCC is to provide a forum for the exchange of information regarding the development of standards for healthcare information systems. The membership of the HISCC consists of designated representatives of organizations involved in the development of standards for healthcare information systems as well as designated representatives of major medical and regulatory organizations with an interest in the use of these standards.

At the initial HISCC meeting the representatives from the IEEE P1157 Committee indicated that the IEEE P1157 Committee was interested in leveraging the efforts of other standards efforts and would work with other groups to develop a convergence path to the OSI environment. This initial proposal was formalized at the Nov 1988 meeting of the HISCC in Washington DC, where the IEEE P1157 Committee advanced the proposal for convergence to the OSI environment shown in Figure 4. The proposal was reviewed by the HISCC representatives and subsequently presented to the SCAMC audience as part of a panel discussion regarding the HISCC.

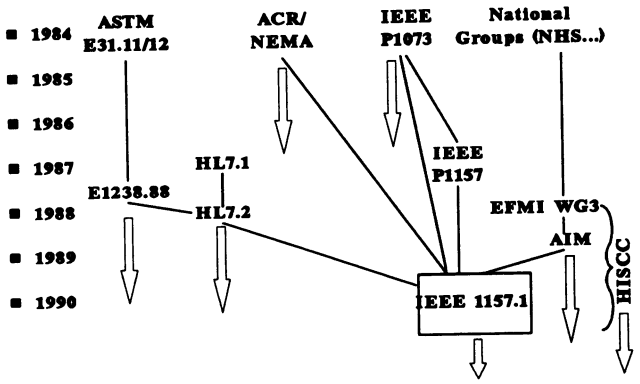

Figure 4 Proposed Convergence to OSI Environment

Since that time the following actions towards convergence have occurred :

1) The ASTM E1238-88 "Standard Specification for Transferring Clinical Laboratory Messages Between Independent Computer Systems" has been used as the basis for both the HL-7 and IEEE P1157 standards in the area of Clinical Laboratory.

2) The IEEE P1157 Committee has decided to base the content of MEDIX on the relevant sections of ASTM, HL-7, and other applicable standards and specifications.

3) The IEEE P1073 Medical Information Bus (MIB) has adopted an ISO/OSI interface which will be architecturally compatible with IEEE P1157.

4) Discussions between ACR/NEMA and IEEE P1157 are in progress, a joint working group has been established with ACR/NEMA WG VIII, and a combined ACR/NEMA WG VIII | MEDIX meeting was held in May 1990.

5) The IEEE P1157 Committee has established a close working relationship with the representatives of the EFMI and AIM efforts, and, more recently, the EWOS and CEN working groups. This has led to the establishment of the Euro-MEDIX Regional Group.

6) The IEEE P1157 Committee has defined a specific goal for providing convergence with HL-7, a joint working group has been created, specific proposals for achieving convergence have been defined, and combined meetings are being planned. HL-7 has MEDIX convergence as one of the stated goals for version 3.0.

Overall, the IEEE P1157 Committee believes that the HISCC approach is working, and that reasonable progress has been made towards convergence of the various healthcare communications standards.

Conclusions

Healthcare communications standards are a necessary condition to accelerating the diffusion of automated information technology in healthcare. The IEEE P1157 Standards, which are international in scope, are being developed by a process of open participation under the auspices of the IEEE EMBS, are being developed to meet strict conformance to the ISO/OSI Standards, and are being coordinated with related healthcare information systems standards, will make an important contribution in this area. The initial focus of the IEEE P1157 Committee will provide a needed subset of the eventual standard in 1990 and the long term focus will provide the groundwork for extension of the effort to cover communications in all of healthcare.

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